PAPE-DAWSON ENGINEERS

NRG ENERGY, INC

LIMESTONE ELECTRIC GENERATING STATION

LIMESTONE COUNTY, TEXAS

HYDROLOGIC ANALYSIS FOR DSDA POND AND ST-18 POND

May 2011

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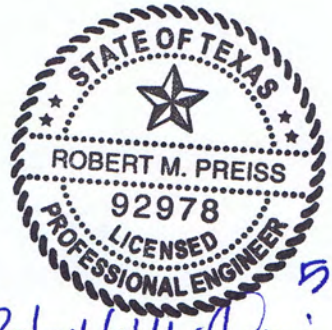


5.4.11

May 2011

Texas Board of Professional Engineers, Firm Registration # 470

PAPE-DAWSON ENGINEERS

INTRODUCTION

Pape-Dawson Engineers, Inc. was contracted to conduct a hydrologic analysis of the Dewatered Sludge Solids Waste Disposal Area (DSDA) and ST-18 ponds within the Limestone Electric Generating Station located in Limestone County near Jewett, Texas. Mr. Chris Vasquez with NRG Energy, Inc. provided direction to evaluate the capacity of each pond for potential bank overtopping during a 100-yr (1% exceedence probability) and 25-yr (4% exceedence probability) storm event. More specifically, NRG requested that Pape-Dawson evaluate the ability of a 2-foot freeboard within the DSDA pond to contain the 100-yr and 25-yr storm events without overtopping the top of bank and to determine whether the ST-18 pond has sufficient capacity to retain a 100-yr and 25-yr storm event while maintaining the same 2-feet of freeboard. The analysis was prepared using information provided by the Client; namely, electronic topographic maps of current site conditions and the existing site plans prepared by EBASCO Services Incorporated, dated April 26, 1982. The assumptions, constraints and results of each pond has been outlined and detailed below.

DSDA POND ANALYSIS

According to information provided by the Client, we understand that the DSDA pond is an impoundment facility for sludge materials consisting of fly ash, bottom ash, boiler slag and/or flue gas emission control residuals. The sludge material is retained within the DSDA pond until it is stabilized into a product suitable for land fill disposal. The pond is not hydraulically connected to any adjacent system; therefore the pond does not receive storm water runoff other than direct rainfall accumulation and surface water runoff from the perimeter maintenance berm. According to the topographic data provided by the Client, a minimum top of bank elevation of 483.41-feet is located at the northwest corner of the facility. The existing total depth of the pond is approximately 12-feet, measured from the minimum top of bank elevation to the bottom of the pond.

According to the rainfall depths vs. frequency values for Texas Counties (NWS TP-40), the total depth of rainfall for the 100-yr and 25-yr 24-hour rainfall events for Limestone County are

10.58-inches and 8.01-inches, respectively. According to the topographic information supplied, the drainage area contributing to the DSDA pond is approximately 4.23-acres. The total volume of runoff the DSDA pond is receiving as a result of direct rainfall accumulation assuming an effective impervious cover of 100% (wet pond) is summarized in the following table:

Storm Frequency	Total Rainfall (Inches)	Drainage Area (Acres)	Total Volume (Acre-foot)
25-yr (4%)	8.01	4.23	2.82
100-yr (1%)	10.58	4.23	3.73

The capacity of the DSDA pond is summarized in the following table and is based upon topographic information provided by NRG Energy, Inc. dated April 14, 2011.

DSDA Pond Capacity			
WS Elev	Volume[1] Cubic Feet	Acre-foot	
471.50	0	0.00	◀Bottom of Pond
472.00	7,572	0.17	
473.00	72,934	1.67	
474.00	167,075	3.84	
475.00	270,159	6.20	
476.00	380,418	8.73	
477.00	497,712	11.43	
478.00	622,269	14.29	
479.00	754,326	17.32	
480.00	894,117	20.53	
481.00	1,043,745	23.96	
481.41	1,109,121	25.46	◀Storage at 2-foot of freeboard
482.00	1,205,172	27.67	
482.16	*1,231,877*	*28.28*	◀*WSE 25-yr event*
482.39	*1,271,516*	*29.19*	◀*WSE 100-yr event*
483.00	1,373,820	31.54	
483.41	1,445,036	33.17	◀Minimum Top of Bank Elevation

1. The volumes were obtained by evaluating the existing topographic information and performing surface volume calculations utilizing surface modeling software by Autodesk's Land Development Software.

The DSDA pond has a total storage capacity of 33.17 acre-feet. However the effective storage capacity of the pond is 25.46 acre-feet if the pond is operated to maintain 2-feet of freeboard from the minimum top of bank elevation. This provides 7.71 acre-feet of storage in the freeboard area, which is equivalent to over two times the volume of runoff from a 100-yr, 24-hour rainfall storm event.

ST-18 POND ANALYSIS

The ST-18 pond is a storm water runoff pond collecting runoff from the Secondary Dewatering and Waste Holding System area. An underground storm water collection system conveys storm water runoff to the pond from an approximately 6.40-acre area within the Secondary Dewatering Waste Holding area. The surface area of the pond is approximately 1.92-acres; therefore the total contributing area the pond is receiving storm water from is approximately 8.32-acres. According to information provided by the Client, a minimum top of bank elevation of 443.00-feet is located at the western portion of the facility. The existing depth of the pond is approximately 19-feet, measured from the minimum top of bank to the bottom of the pond.

The total volume of runoff the ST-18 pond receives as a result of runoff from the Secondary Dewatering Waste Holding area, direct rainfall accumulation from the pond surface and runoff from the perimeter maintenance berm is summarized in the following table (conservatively assuming an effective impervious cover of 100% for the hard packed ground and wet pond):

Storm Frequency	Total Rainfall (Inches)	Drainage Area (Acres)	Total Volume (Acre-foot)
25-yr (4%)	8.01	8.32	5.56
100-yr (1%)	10.58	8.32	7.34

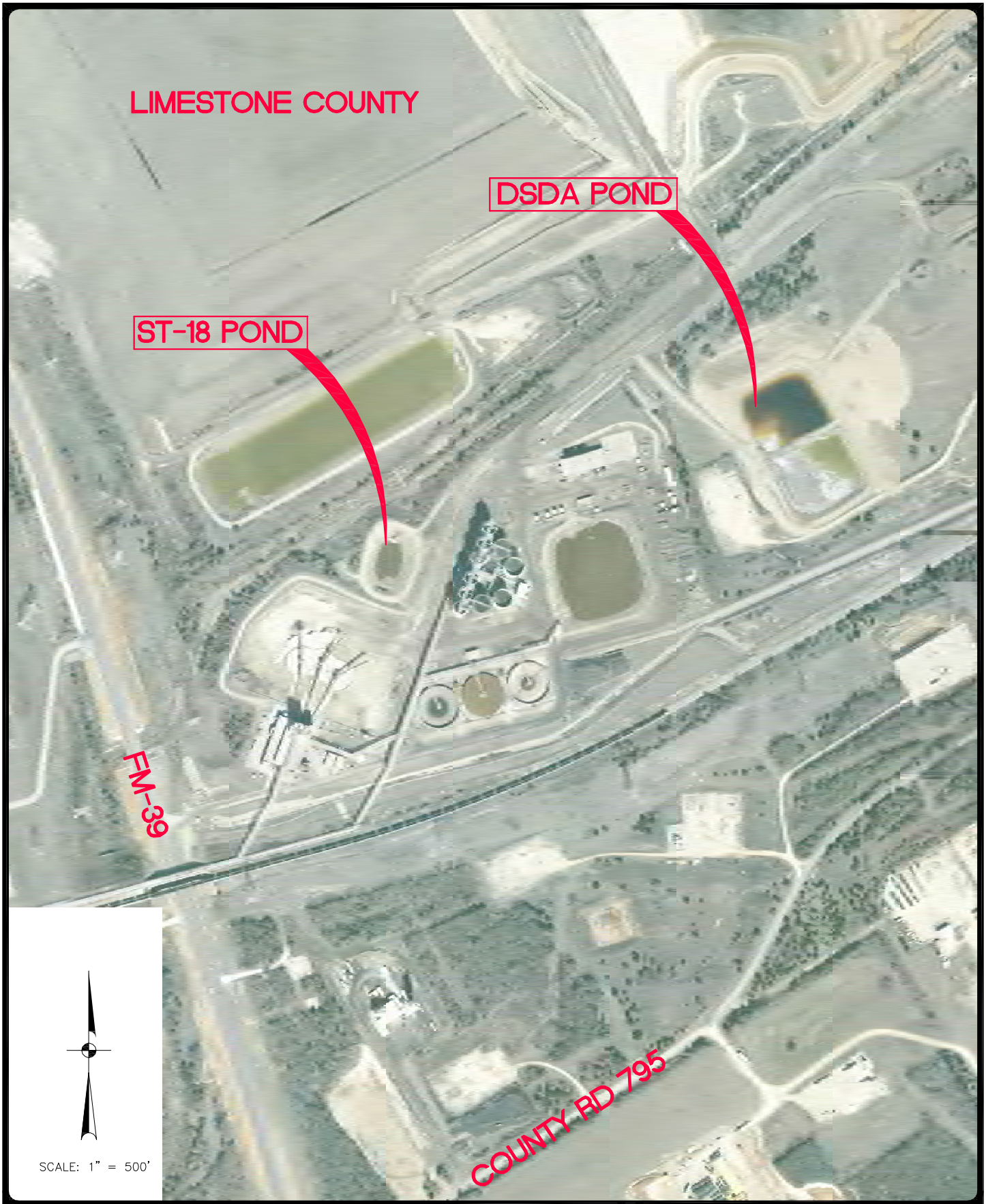
The ST-18 pond capacity is summarized in following table based on topographic information provided by NRG Energy, Inc., April 14, 2011.

ST-18 Pond Capacity			
	Volume		
WS Elev	Cubic Feet	Acre-foot	
424.00	0	0.00	◄Bottom of Pond
425.00	635	0.01	
426.00	3,209	0.07	
427.00	7,683	0.18	
428.00	13,656	0.31	
429.00	21,336	0.49	
430.00	30,918	0.71	
431.00	42,398	0.97	
432.00	55,848	1.28	
433.00	71,378	1.64	
434.00	89,060	2.04	
435.00	108,834	2.50	
436.00	130,684	3.00	
437.00	154,469	3.55	
438.00	180,116	4.13	
439.00	207,715	4.77	
440.00	237,343	5.45	
440.15	*242,194*	*5.56*	◄*WSE 25-yr Event (retained, no pumps)*
441.00	269,077	6.18	◄Storage at 2-foot of freeboard
442.00	302,983	6.96	
442.46	*319,730*	*7.34*	◄*WSE 100-yr Event (retained, no pumps)*
443.00	339,166	7.79	◄Minimum Top of Bank Elevation

1. The volumes were obtained by evaluating the existing topographic information and performing surface volume calculations utilizing surface modeling software by Autodesk's Land Development Software.

The ST-18 pond has a total storage capacity of 7.79 acre-feet. The total runoff volume the pond receives during a 100-yr and 25-yr 24-hr rainfall event is 7.34 acre-feet and 5.56 acre-feet, respectively, resulting in approximately 0.45 acre-feet of available storage prior to the pond being overtopped. However, in order for the pond to maintain 2-feet of freeboard from the minimum top of bank elevation, the effective storage of the pond is then reduced to 6.18 acre-feet. The pond is equipped with two (2) 250-gpm pumps to drain the pond. Therefore during the course of a 100-yr storm event both pumps will need to operate for at least twelve and a half (12.5) hours to maintain the minimum 2-feet of freeboard.

EXHIBITS



SCALE: 1" = 500'

JOB NO. 40010-00

DATE APRIL 2011

DESIGNER CNH

CHECKED RMP DRAWN ARH

SHEET 1

NRG ENERGY, INC.

LOCATION MAP

LIMESTONE COUNTY, TEXAS

PAPE-DAWSON ENGINEERS

10333 RICHMOND AVE | HOUSTON, TEXAS 77042 | PHONE: 713.428.2400
SUITE 900 | FAX: 713.428.2420

TEXAS BOARD OF PROFESSIONAL ENGINEERS, FIRM REGISTRATION # 470

Date: May 04, 2011, 9:22am User ID: CHarris
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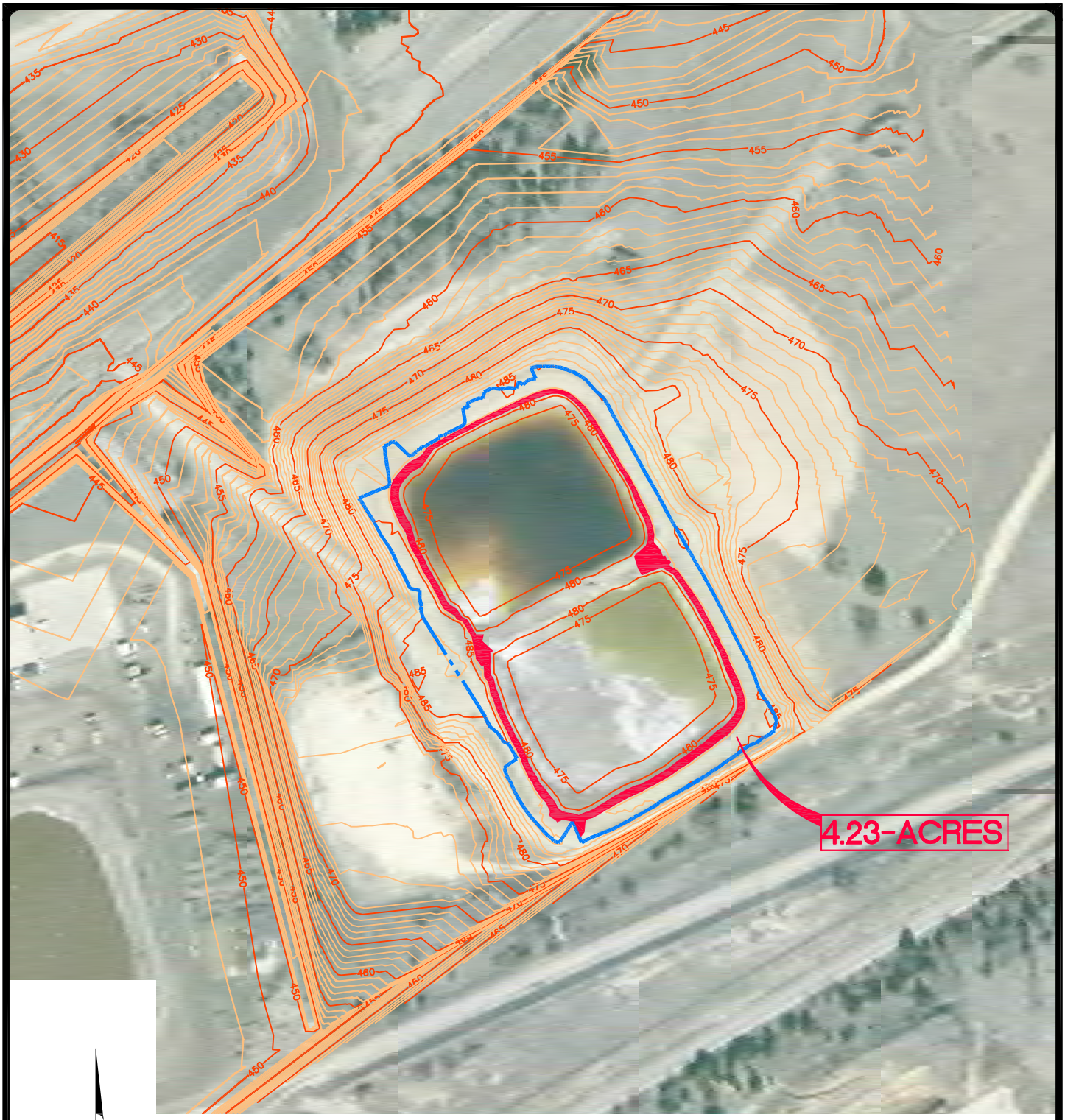


SCALE: 1" = 200'

LEGEND

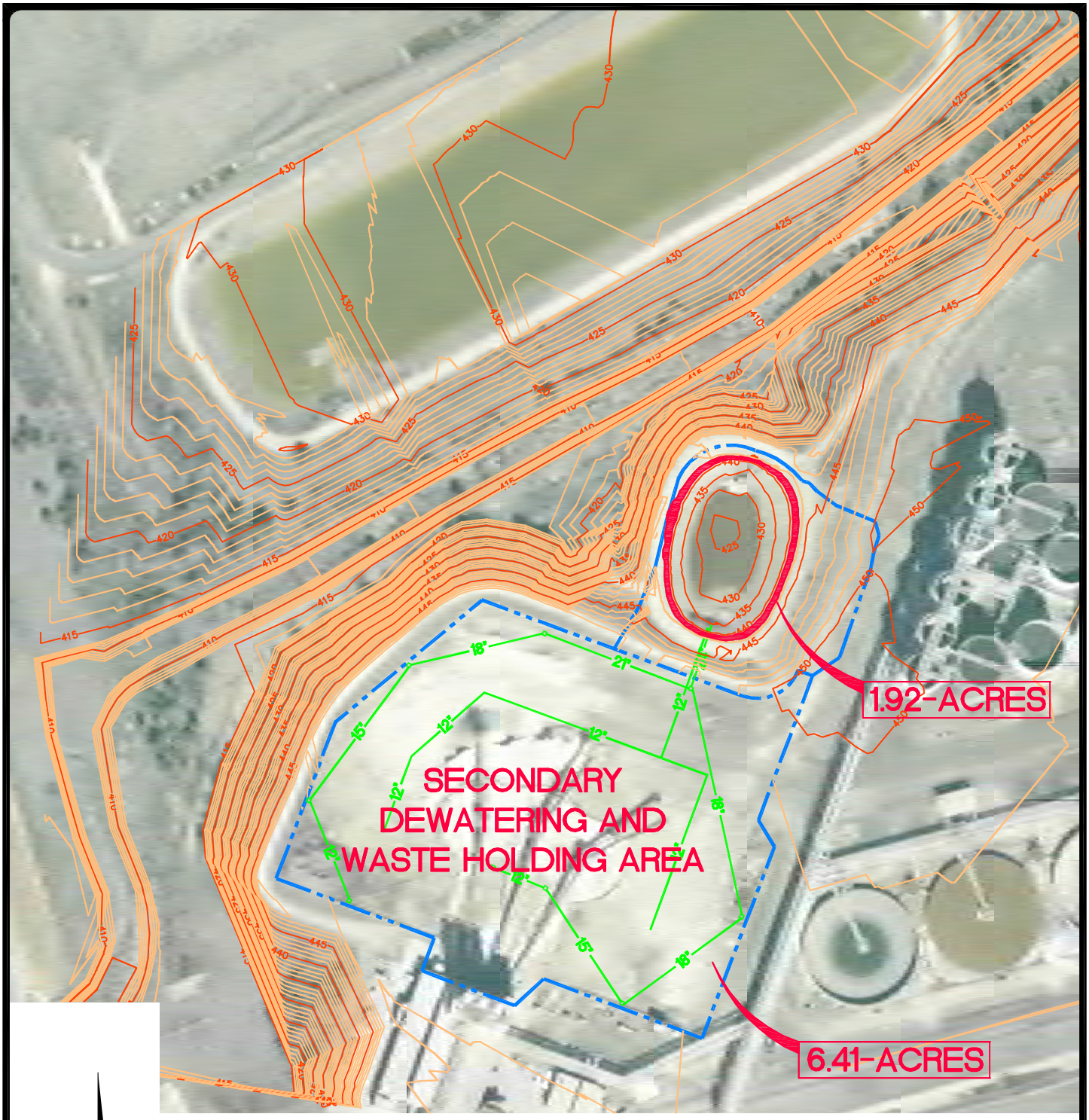
- DELINEATED DRAINAGE AREA
- EXISTING CONTOURS (1' ELEV.)
- 480 EXISTING CONTOURS (5' ELEV.)
- 2' FREEBOARD

JOB NO. 40010-00
DATE APRIL 2011
DESIGNER CNH
CHECKED RMP DRAWN ARH
SHEET 2

NRG ENERGY, INC.
DSDA HYDROLOGIC ANALYSIS
LIMESTONE COUNTY, TEXAS

PAPE-DAWSON ENGINEERS
10333 RICHMOND AVE | SUITE 900 | HOUSTON, TEXAS 77042 | PHONE: 713.428.2400 FAX: 713.428.2420
TEXAS BOARD OF PROFESSIONAL ENGINEERS, FIRM REGISTRATION # 470

Date: May 04, 2011, 9:23am User ID: CHarris
File: K:\projects\400\NRG-Hdro-Data\TIN Complete.DWG



SCALE: 1" = 200'

LEGEND

- DELINEATED DRAINAGE AREA
- EXISTING CONTOURS (1' ELEV.)
- 50 — EXISTING CONTOURS (5' ELEV.)
- 24" INLET — EXISTING STORM SEWER FACILITIES
- 2' FREEBOARD

JOB NO. 40010-00
DATE APRIL 2011
DESIGNER CNH
CHECKED RMP DRAWN ARH
SHEET 3

NRG ENERGY, INC.
ST-18 HYDROLOGIC ANALYSIS
LIMESTONE COUNTY, TEXAS

PAPE-DAWSON ENGINEERS
10333 RICHMOND AVE | HOUSTON, TEXAS 77042 | PHONE: 713.428.2400
SUITE 900 | FAX: 713.428.2420
TEXAS BOARD OF PROFESSIONAL ENGINEERS, FIRM REGISTRATION # 470

Date: May 04, 2011, 9:23am User ID: CHarris
File: K:\projects\400\NRG-Hdro-Data\TIN Complete.DWG

APPENDIX

HOU-3037 M-113620 S03

PLAN - SLUDGE STABILIZATION FACILITY

NO	DATE	REVISION	BY	CH	APPROVED
1	7-21-82		PSH	HM	

REV: (H12-H14) ROAD; (I7-I9) DRAINAGE, (G3) CREEK WIDTH; (D8, G4) LOC. OF SAN WASTE TREAT PLANT; (B19-I2 + D19 THRU I19) DITCH; (E18, G9, J8) PIPE; (J4) H.P EL; (D18, E15, E16, F17, I9, J8, J9, L10, L17) SLOPE & INV EL. ADD: (H12) DRAINAGE; (H14) SWGR. BLDG; (C14) NOTE: (K2) LINED AREA; (J5, J12) DWG NO.; (L20) REF DWG; (K5) PIPE; (A16, B14, B17, K19, L2, L12, L14, M6) DITCH & COORD; (I11, I15, J15 THRU J18, K9) SLOPE & INV EL. DEL: (E13) NOTE N.R.

NO	DATE	REVISION	BY	CH	APPROVED
2	10-29-82		B.F	SKB	

REV: DCN'S C-235, C-275, C-313 & FCN-059 INCORP.; (H6, H8, K10, J10 ~ J14) DRAIN PIPE; (J14 ~ J18, H14, D14, D2, C4, B4) DITCH; (G2, C9 ~ C13) LYNN CREEK SLOPE & INV. (F8) SAN TREAT. FAC AREA; (G14, H13 ~ H14) ROAD RAD & W.P. ADD: (H4) CULV: (F11) SUMP; (F11) NOTE - N.R., (I3) TRANSMISSION TWR; (G20) NOTE. DEL: (F11) POND DISCHARGE & OVERFLOW PIPES; (H16) W.P.

NO	DATE	REVISION	BY	CH	APPROVED
3	5-16-83		PSH	HM	

DCN "C-534 & FCN "168 INCORP. REV: (D14) CRUSHED STONE PVMT. (D14, (E16, H18) LOC. OF CULV; DIESEL FUEL STORAGE TK. (F18, I18) RC PAVED RD & COORD; (K9) DITCH; (I11) INV EL; (F9 TO 14) SLOPE EDGE & TOE LINE. ADD: (E23) DWG NO; (D19) CONC PAVED AREA 'E'; (C20) REF DWG; (E9) ACCESS, (D15) CB-529, (D19) RC PAVED RD. & COORD. CB-529; (N20) SCOPING NOTE; (J3, M4) DIESEL FUEL STORAGE TK. DEL: (G18) GASOLINE TANK; (I19) EQUIP & FACILITY BY HL&P

NO	DATE	REVISION	BY	CH	APPROVED
4	6-29-83		B.F	SKB	

ADD: (D9) EMERGENCY SPILLWAY, (N20) REF DWG. DEL: (K3, D10) NOTE - N.R.

NO	DATE	REVISION	BY	CH	APPROVED
5	12-9-83		HM	SKB	

DCN C-745; C-758; C-779 & C-797 INCORP. REV: ROAD PAVEMENT AS PER HL&P'S REQUEST; (E8) SAN TREAT FACIL.; (E16) DRAINAGE; (C18-D16, F20) NOTE; (H15) DITCH INV. (J4) DG ROOM SIZE. ADD: (E15) TRUCK WASH-DOWN AREA. (E20, G20, I16, J11, E15) NOTES; (C14) DIM; (N20) REF DWG; (D9) 13.1 MCC FDN; (F19) POWER CT FDN; (K7, D18) NOTE -NR. DEL: (E20) QTY; (H16, J14) NOTE.

NO	DATE	REVISION	BY	CH	APPROVED
6	2-14-84		PSH	HM	

REV: (L11, N20) NOTE. DEL: (K7, D18) NOTE - NR.

NOTES

FOR QUANTITIES SEE M-113620 S05 & S06

FOR ROADS AND CONCRETE PAVING SEE NOTES ON DWG M-101604 S01.

ALL VERTICAL CURVES FOR ROADS TO BE 100' LONG.

GEODETIC EL 450.00' CORRESPONDS TO PLANT REFERENCE EL 100.00'.

TOP OF DITCH BANK TO BE AT LEAST 1'-0 ABOVE TOP OF FABRIFORM LINING (HF).

DENOTES 6" CRUSHED STONE ROAD OR PAVING

DENOTES CONCRETE PAVING

FOR HAUL ROAD DUST CONTROL PAVING SEE M-113620S07

FOR GRADING NOTES SEE DWG M-113600 S04

FOR DRAINAGE NOTES SEE DWG M-101600 S01

REFERENCE DRAWINGS:

BAR BENDING SCHEDULE	B-148620-130
ENLARGED SITE PLAN PLANT AREA (MECH)	M-001600
PLOT PLAN SH 3 (MECH)	M-001601503
GRADING & DRAINAGE-GENERAL PLAN	M-101600S01
GRADING & DRAINAGE-PLANT AREA SECTS & DETS SH. 1	M-101602S01
ROADS - PLAN	M-101604S01
SITE - PLAN	M-101608
SWDA-GRADING PLAN	M-113600S04
SWDA-DRAINAGE PLAN	M-113610S03
SWDA-RAILROAD SPUR PLAN SECTS & DETS	M-113620S04
SWDA-SLUDGE STABILIZATION FACILITY DRAINAGE-SECTS & DETS	M-113620S05
SWDA-SLUDGE STABILIZATION FACILITY ROADS AND PAVING-PLAN, SECTS & DETS	M-113620S06
SWDA-HAUL ROADS PLAN	M-113620S07
SWDA-HAUL ROADS SECTS & DETS	M-113620S08
SWDA-RUNOFF POND AREA 1 PLAN, SECTS & DETS	M-113621S01
SWDA-DEWATERED SLUDGE SOLIDS DISPOSAL AREA-PLAN SECTS & DETS	M-113621S05
AQCS SWDA DRAINAGE TRENCHES PLAN, SECTS. DETS.	M-104604S17
SWDA DRAINAGE SECT & DET SH 1	M-113610S04
SWDA SECONDARY DEWATERING & WASTE HANDLING SYSTEM SH 1	M-113635S01
AQCS-SWDA THICKENER FOUNDATION SH 1	M-104604S01
SWDA-SANITARY TREATMENT FACILITY	M-113605S01
SWDA-API SEPARATOR-MASONRY	M-113636S01
SWDA-API SEPARATOR AREA MISC EQUIP FDNS	M-113636S03
SWDA-STORM WATER RUN OFF POND STACK AREA SUMP STRUCTURE	M-113622S01
AQCS SWDA THICKENER AREA PAVING PLAN, SECTS & DETAILS	M-104604S18
HYDROBIN SWGR BLDG-PLAN & SECT (HVAC)	M-057789

The below listed DCN's and FCN's have not been incorporated as of the last Ebasco Revision.
NONE

ALL WORK BY SWDA FDN CONTRACTOR EXCEPT AS NOTED

NO	DATE	REVISION	BY	CH	APPROVED
7	9-7-84		VP	SKB	

FCN'S 068, 128 & 262 INCORP. REV: (L2-L15) DRAINAGE DITCH; (K4) TANK LOC & GRADING; (K14-K19) GRADING & DRAINAGE DITCHES (J15, J17, J18) DITCH EL & SLOPE. ADD: (P13, N16) NOTES DEL: (J16) CATCH BASIN TRANSFER REVISION TO HL&P

After Rev. 7, dated 9/7/84, to this drawing, full responsibility for the maintenance of this drawing and for subsequent modifications made or required to be made to this drawing is assumed by Houston Lighting and Power Company (HL&P). Ebasco Services Incorporated has no responsibility for maintenance and modifications after said drawing revision number. All Design Change Notices (DCN's) and Field originated changes which have been incorporated on this drawing prior to said drawing revision number on this drawing are identified in the drawing revision block. All DCN's and those field originated changes identified to Ebasco, which have not yet been incorporated on this drawing, have been identified by drawing note.

NO	DATE	REVISION	BY	CH	APPROVED
8	5-1-85	ADDTNL. ROADS INCORP.			

REV	DATE	CONSTRUCTION CONTRACT ISSUES	BY
		PBOA AWARD	
		PBOA BID	
		FUG AWARD	
		FUG BID	
		SITE PREP AWARD	
1A	5-21-82	SITE PREP BID EAST	PSH

WORK THIS DWG WITH DWGS M-113610S03, M-113620S05 & M-113620S06.

HOUSTON LIGHTING & POWER CO.
LIMESTONE ELECTRIC GENERATING STATION
UNIT 1, 750 MW 1985 INSTALLATION
UNIT 2, 750 MW 1986 EXTENSION

SOLID WASTE DISPOSAL AREA
SLUDGE STABILIZATION FACILITY
ROADS, PAVING & DRAINAGE - PLAN

EBASCO SERVICES INCORPORATED

SCALE 1"=60' | APPROVED | DATE 4/21/82
DIV. CIVIL | DR. FRANK DAVID | CH P.S HUANG | SKD
HOU-3037
M-113620 S03